

## WHAT IS CLAIMED IS:

### Parametric synthesized image transforms and visual effect parameter sets

1. An image processing method comprising:  
generating a synthesized image transform from a set of synthesizing parameters;  
and  
subjecting the input image to the synthesized image transform to form an output image wherein:  
the synthesized image transform is generated from a set of synthesizing parameters;  
the synthesizing parameters have a defined domain of allowed values;  
the complete set of synthesized transforms is obtained by varying the synthesizing parameters over all values within the domain;  
the visual effect of each synthesized transform is characterized by a set of visual effect parameters; and  
the visual effect parameters and the synthesizing parameters are related in that  
the visual effect parameters are generated from the synthesizing parameters for the complete set of transforms, or  
the synthesizing parameters are generated from the visual effect parameters for the complete set of transforms.

### Composability and sequential equivalency

#### Composition function

2. The method of claim 1 wherein:  
the synthesizing parameter sets are composable; that is, a function or algorithm combines two or more sets of synthesizing parameters into a single set of synthesizing parameters; and  
the composed synthesizing parameters are sequentially equivalent; that is, an image processed sequentially by two or more synthetic transforms will be equivalent to an image processed through a single transform which has been synthesized from the synthesizing parameter set composed from the synthesizing parameter sets of the sequential transforms.

3. The method of claim 2 wherein the equivalency of the single image transform and the sequential image transform is measured by mean square error.

4. The method of claim 2 wherein the equivalency of the single image transform and the sequential image transform is measured by visual effect parameters.

5. The method of claim 2 wherein the synthesizing parameter set composition function and the synthesizing parameter set to visual effect parameter estimation function are used to calculate or estimate a visual effect parameter composition function.

Attenuating, amplifying or reversing a transform

Scalar composition function

6. The method of claim 1 wherein:  
there is a given synthesized transform and parameter array;  
an arbitrary scalar value,  $a$ , is selected;  
a scalar composition function that combines the scalar value with the parameter array to create a new parameter array is calculated or estimated; and  
a new transform is synthesized from the new parameter array.

7. The method of claim 6 wherein there is a scalar value  $a_0$  wherein the new synthesized transform is the identity transform.

8. The method of claim 5 wherein for each value of  $a$ , there is another scalar  $a_{inv}$  such that the transform synthesized from the scalar composition of the parameter array and  $a_{inv}$  is the inverse transform the transform synthesized from the scalar composition of the parameter array and the scalar  $a$ .

9. The method of claim 2 and claim 5 wherein:  
an arbitrary scalar value is given for each of the parameter sets, and  
the scalar composition function combines the corresponding scalars and parameter sets, and

the composition function combines the parameter sets into a single parameter set.

Claims about how the system is optimized.

10. The method of claims 2 and 5 wherein a minimum set of “critical” transforms is used and the composition function and scalar composition function are used to generate all other transforms in the complete set.

Creating or authoring intended or desired results

11. The method of claim 1 wherein:  
the desired output visual effect is characterized by a set of visual effect parameters  
the synthesizing parameter sets are calculated or estimated from the set of visual effect parameters.

12. The method of claim 2 wherein:  
the desired output visual effect is characterized by two or more sets of visual effect parameters  
the synthesizing parameter sets are calculated or estimated from each of the sets of visual effect parameters;  
a single synthesizing parameter set is calculated from the multiple parameter sets using the composition function or algorithm.

13. The method of claim 2 wherein:  
the desired output visual effect is characterized by two or more sets of visual effect parameters  
a single equivalent set of visual parameters is calculated or estimated from the two or more sets of visual effect parameters;  
a single synthesizing parameter set is calculated or estimated from the single equivalent set of visual parameters.

Simulation

14. The method of claim 1 wherein:

an input image is processed by a sequence of one or more arbitrary image transforms to produce an output image

the visual effect of the output image is characterized by a set of visual parameters;

the synthesizing parameter set is calculated or estimated from the set of visual effect parameters.

15. The method of claim 2 wherein:

an input image is processed by a sequence of two or more arbitrary image transforms to produce an output image

the visual effect of each transform is characterized by a set of visual parameters;

the synthesizing parameter sets are calculated or estimated from the sets of visual effect parameters;

a single synthesizing parameter set is calculated from the multiple parameter sets using the composition function or algorithm.

#### Visual parameters

#### Selective transforms

16. The method of claim 1 wherein some of synthesized transforms in the complete set are selective transforms; that is, transforms that are applied only to a particular combination of objects, image locations and range of colors in the input image and leave the image unchanged elsewhere.

17. The method of claim 14 wherein the transition from the selected region to the non-selected region is a smooth.

#### Gamut compliances

18. The method of claim 1 wherein the some of transforms preserve data values on gamut, which is defined as a specified surface in color space.

19. The method of claim 9 wherein data values on the gamut surface remain on the surface, but may be moved to different locations on the surface.

20. The method of claim 9 wherein data values not on the gamut surface are not moved onto the surface or across the surface.

#### Line compliances

21. The method of claim 1 wherein the some of transforms preserve data values on a line, which is defined as a trajectory in color space. (An example is the neutral axis, which is a line that maps to equal values of CIE X,Y,Z on a color device.)

22. The method of claim 9 wherein data values on the line remain on the line, but may be moved to different locations on the line.

23. The method of claim 9 wherein data values not on the line are not moved onto the line.

24. The method of claim 9 wherein the transform has continuous slope on the line.

#### Hue compliances

25. The method of claim 1 wherein the some of transforms preserve hue. A hue is preserved if a color is transformed to a new color by adding or subtracting black (shading) and adding or subtracting white (tinting).

26. The method of claim 18 wherein two value of (r,g,b) are transformed and the third value is calculated by the hue preserving constraint.

27. The method of claim 19 wherein for each pixel, the two values used for the transform are the largest and smallest, and the value calculated is the intermediate.

#### Execution of the synthesized transform

28. The method of claim 1 wherein the synthesized transform is executed in either software, hardware, firmware, or some combination thereof.

29. The method of claim 1 wherein the synthesized transform is executed in either a source device, output device, mobile device, computer workstation, archival system or during transfer between devices.

30. The method of claim 1 wherein the synthesized transform is executed in a network topology in either a server device, client device, peer-to-peer device or during transfer between devices.

Claims about how the parameter sets are managed, stored and retrieved

31. The method of claim 1 wherein one or more parameter sets are stored in one or more files;

32. The method of claim 1 wherein the parameter sets are stored in a data structure such as defined by a C code struct or by an XML tagged structure

33. The method of claim 29 wherein the file contains meta information such as creation date, author related to each parameter set.

34. The method of claim 29 wherein a particular parameter set is selected and where the selection is made

by a graphics user interface

by a hardware user interface such as a dial or button

by a browser interface

by a program

by environmental

by device

by an expert system

Claims about how the parameter sets are created and edited

35. The method of claim 1 wherein a new parameter array is created or an existing parameter array is edited or modified by means of one or more of interactive controls, declarative statements, command language, an application, a browser application, or form based.

Claims about the types of transforms in the complete set

36. The method of claim 1 wherein the complete set of synthesized transforms include any or all of the following types of transforms:

- device color correction;
- visual enhancement;
- visual dynamic range enhancement;
- gray removal;
- spatial;
- compression improvement;
- compression artifact reduction; or
- adaptive spatial filter.

37. Image processing apparatus comprising:

- input and output devices;
- a processor;
- storage for instructions and data;
- the processor and storage being configured to:
  - generate a synthesized image transform from a set of synthesizing parameters;

and

subject the input image to the synthesized image transform to form an output image wherein:

- the synthesized image transform is generated from a set of synthesizing parameters;
- the synthesizing parameters have a defined domain of allowed values;
- the complete set of synthesized transforms is obtained by varying the synthesizing parameters over all values within the domain;
- the visual effect of each synthesized transform is characterized by a set of visual effect parameters; and
- the visual effect parameters and the synthesizing parameters are related in that

the visual effect parameters are generated from the synthesizing parameters for the complete set of transforms, or

the synthesizing parameters are generated from the visual effect parameters for the complete set of transforms.